Abstract

The invention is directed to fabric-based inserts and layers for use with tires in order to provide an improved level of puncture resistance to the tire. Disclosed embodiments of the invention include tire anti-puncture layers including puncture-resistant layers that comprise a single or multiple layers of fabric. Preferably, for low cost and low abrasion, the puncture-resistant layers comprise fibers having a tensile strength or tenacity of less than about 15 g/denier. In some preferred constructions, especially where the puncture-resistant layer comprises a single layer of fabric, the puncture-resistant layer comprises a high cover factor, tightly woven fabric, for example having a round packed cover factor of at least about 40% of full in the warp direction and at least about 65% of full in the fill direction. In other embodiments, especially where the puncture-resistant layer comprises multiple layers of fabric, lower cover, less tightly woven woven fabrics can be used, or, alternatively, non-woven fabrics such as knitted or felted fabrics (felts) can be used. Some such preferred, less tightly-woven fabrics are woven from untwisted yarns, enabling the fibers or filaments comprising the yarns to spread out into a tape-like configuration under compression, thereby increasing the effective cover factor and level of puncture resistance over that predicted from the round packed cover factor. A "taped fiber density" calculation is presented for predicting the effective cover factor of such taped-out woven fabrics, and certain preferred embodiments of such fabrics have a taped fiber density of at least about 80% of full in at least one of the warp and fill directions. In some embodiments, the puncture-resistant layer, or one or more layers of fabric comprising the layer, are coated with polymeric coatings to increase the level of puncture resistance. In some embodiments, the tire anti-puncture device is configured as a separable strip that can be placed within a tire to act as a liner. In other embodiments, the puncture-resistant device is incorporated within the cross-section of the tire body itself. While the tire anti-puncture device in some embodiments comprises just the puncture-resistant layer, in other embodiments, one or more low abrasion layers can be added to isolate and protect the tire and/or inner tube, if present, from the puncture-resistant layer. Such law abrasion layer(s) are particularly useful for embodiments involving puncture-resistant layers coated with polymeric coatings containing abrasive fillers, which can serve to increase puncture resistance but tent also to increase abrasiveness of the puncture-resistant layer.